

# The Derwent Valley Water Board

A short Description of the Undertaking

# THE DERWENT VALLEY WATER BOARD

A SHORT DESCRIPTION OF THE UNDERTAKING

HEAD OFFICES . BAMFORD . NR. SHEFFIELD



OPENING OF LADYBOWER RESERVOIR BY H.M. KING GEORGE VI. FOR MANY YEARS prior to the end of the nineteenth century the upper reaches of the River Derwent and its tributary, the River Ashop, had attracted the attention of Water Engineers as potential sites for large impounding reservoirs and in the Parliamentary Session of 1898-99 the Corporations of Derby, Leicester and Sheffield each promoted a Bill for powers to construct such reservoirs and to carry away the water for use within their respective areas of supply.

The promotion of these Bills brought to a head the conflicting claims to rights in the waters of the River Derwent not only of the three promoting Corporations but also of Nottingham Corporation and local authorities in Derbyshire. As a result of negotiations to resolve the various claims it was eventually agreed that a Board should be formed for the purpose of constructing the proposed reservoirs and supplying the water there from in bulk to the four Corporations and to the local authorities in Derbyshire (excluding the area within the Rother Valley) on the basis that the local authorities should be entitled to call for supplies up to an aggregate maximum of 5 m.g.d. and that the remainder of the water should be supplied to the four Corporations in the following proportions :—

Derby Corporation	 	25.00%
Leicester Corporation	 	35.72%
Nottingham Corporation	 	14.28%
Sheffield Corporation	 	25.00%

This agreement formed the basis of the Derwent Valley Water Act 1899 which received the Royal Assent on the 9th August, 1899, and by which the Derwent Valley Water Board was incorporated as a Statutory Water Undertaking with its Head Office at Bamford, Derbyshire. The Act provided that the Board should consist of thirteen members to be appointed annually as follows :—

by the Derby Corporation	 3 members
by the Leicester Corporation	 4 members
by the Nottingham Corporation	 2 members
by the Sheffield Corporation	 3 members
by the Derbyshire County Council	 1 member

The 1899 Act conferred powers on the Board to construct the impounding reservoirs for which plans had been deposited in connection with one or other of the three original Bills, but the Act contemplated that the works would be carried out by instalments with the first one being capable of supplying not less than 12 million gallons per day. The

Board accordingly decided that the first instalment should consist of the construction of the Howden Reservoir and the Derwent Reservoir with the necessary aqueducts and filters.

By the Derwent Valley Water Order, 1969, which came into operation on 1st January, 1970, the whole basis of supply was changed and is now as follows :—

Water Authority	Maximum quantity of water in any de		
South Derbyshire Water Board	16,093,000 gallons		
Leicester Corporation	15,136,000 "		
Sheffield Corporation	10,593,000 "		
Nottingham Corporation	6,051,000 "		
North Derbyshire Water Board	1,720,000 "		

#### THE FIRST INSTALMENT HOWDEN AND DERWENT RESERVOIRS

The first excavation for the construction of the Howden Dam began in July, 1901, and for the Derwent Dam in July, 1902.

Both the dams are of similar design and are constructed of masonry 178 feet thick at the base tapering to 10 feet thick at the overflow crest. The Howden dam is 117 feet high and 1,080 feet long and forms the Howden Reservoir with a holding capacity of 1,980 million gallons. The Derwent Dam is 114 feet high and 1,110 feet long, and forms the Derwent Reservoir with a holding capacity of 2,120 million gallons. The construction of these two dams required some  $1^{-1/4}$  million tons of stone which was obtained from the Bolehill Quarry above Grindleford Station, carried about 4 miles over the then Midland Railway Company's main line to the Board's sidings at Bamford and thence by the Board's own railway a further 6 or 8 miles to the site of the dams. A village of huts, known as Birchinlee Village, with school, mission room, hospital, shops and recreation room, was erected by the Board half-way between the two dams for the workmen and their families, and the Board's railway was used not only for the purpose of carrying stones, cement and other material to the dams, but also by the workmen and their wives and families, when they wished to go to Bamford or further afield. The village formed an isolated self-contained community with a population of about one thousand persons but the site is now part of the Board's plantations. The Howden Reservoir was formally opened by the late Sir Edward Fraser, then Chairman of the Board, on September 5th, 1912, and the Derwent Reservoir was brought into use in 1916.

#### FILTERS AND AQUEDUCTS

For supplying the water impounded by the Howden and Derwent Dams, the Board constructed Slow Sand Filters at Bamford and an Aqueduct consisting partly of cut-and-cover, partly of tunnel and partly of pipe-line. The Aqueduct is 54 miles long and extends from the Howden Reservoir to the 28 million gallon capacity covered Service Reservoir at Ambergate (some five miles south of Matlock), where it divides, one branch of the Aqueduct (for the supply to Derby and Leicester) running in a southerly direction through Coxbench and Chaddesden to the southern boundary of the County at Sawley and the other branch, for Nottingham, running in a south-easterly direction to Langley mill at the easterly boundary. Flow is by gravitation throughout.

On the completion of the First Instalment the total quantity of water available for supply was 13.434 million gallons per day.

#### THE SECOND INSTALMENT

In 1920 the Board obtained powers to divert the waters of the rivers Ashop and Alport into the Derwent Reservoir, thus increasing the water available for supply from 13.434 million gallons per day to 20.064 million gallons per day. This work, begun in 1921 and completed in 1930, entailed the construction of weirs across the rivers and an aqueduct  $2^{3/4}$  miles long, of which 1,100 yards are in tunnel through the range of hills which separates the Ashop Valley from the Derwent Reservoir. In order to deal with the increased supplies certain lengths of pipe-line on various sections of the Aqueduct were duplicated, and a mechanical filtration plant comprising seventy-two 8 ft. diameter pressure filters with a capacity of 9 million gallons per day was erected at Yorkshire Bridge.

The Ashop and Alport Diversions, the Yorkshire Bridge Filter House and the duplication of the pipe-line made up the Second Instalment of the Board's Works.

#### THE THIRD INSTALMENT

#### LADYBOWER RESERVOIR

By the Derwent Valley Water Act 1920 the Board obtained statutory powers to abandon such of the Reservoirs authorised by the Act of 1899 as had not then been constructed and in their place to construct the Ladybower Reservoir. For geological and other reasons the dam of the Ladybower Reservoir is totally different, both in appearance and structure, from those of the Howden and Derwent Reservoirs. It consists of an earth- work embankment with a clay core under which a trench has been excavated (to an average depth of 180 feet, and maximum depth of 255 feet) and filled with concrete to prevent the water in the Reservoir finding its way through the natural ground beneath the embankment. When the Reservoir is full the surplus water, instead of flowing over the crest of the dam, falls into two funnel-shaped overflows, each 80 feet in diameter and is carried away under the embankment through tunnels 15 feet in diameter and discharged into the tail bays.

Boreholes were driven into the natural ground below the bottom of the concrete filled trench and at both ends of the embankment and cement grout forced under pressure into any fissures in the strata through which the water might find its way beneath or round the ends of the embankment. The total length of the boreholes is 8 miles, the deepest being 400 feet, and 13,000 tons of cement were used for this purpose alone.

The embankment is 1,250 feet long and 140 feet high; its greatest thickness is 665 feet, tapering to 17 feet at the top and the storage capacity of the Reservoir is 6,310 million gallons. The Aqueduct carrying the water southwards from the Derwent and Howden Reservoirs runs along the sides of the Ladybower Reservoir, and as the Aqueduct is at a higher level than the Reservoir, provision has been made for pumping water from the Reservoir into the Aqueduct. The greater part of the electric power required for this purpose is generated by the outflow of Compensation Water.

100,000 tons of concrete, 1,000,000 tons of earth and 100,000 tons of clay were used in the construction of the trench and the embankment. The clay was obtained from land between Bamford and Hope and was brought on the site over a standard gauge private railway, approximately two miles in length, connecting the site of the embankment with sidings adjoining the main line railway at Bamford.

Although the Reservoir was formed by means of an earthwork embankment with a clay core, a large amount of stone was required for beaching and pitching the upstream side of the embankment and for the retaining walls, buildings and other structures. Fortunately, an unlimited quantity of suitable gritstone was available close to the site of the dam and a large proportion was obtained from the Board's own quarry at Ladybower. Other stone was obtained from quarries near Rowsley and sawn and dressed upon the site.

The construction of the Ladybower Dam commenced in 1935 and was carried on throughout the 1939-45 War in spite of the immense difficulties of obtaining labour and materials. The filling of the Reservoir commenced on March 18th, 1943, when the then Chairman of the Board, Alderman Sir Albert Atkey, closed the outlet valve.

The Works were formally inaugurated by His Majesty King George VI on the 25th September, 1945.

Other works necessitated by the construction of the Ladybower Reservoir comprised Road Diversions (including two large Viaducts), Filters Extensions and Aqueduct Works.

Some two miles of the highway from Glossop to Sheffield, a similar length of the road from Ashopton to Derwent and a rather shorter length of the Road from Bamford to Ashopton fell within the area of the Ladybower Reservoir. This entailed the construction of 5  $^{1}/_{4}$  miles of new roads and of two massive Viaducts of reinforced concrete carrying these new roads, water mains and Post Office cables over arms of the Reservoir.

The water mains—consisting of two lines of pipes 48 inches in diameter—and the Post Office cables are laid in an enclosed passage constructed under the road surface of each Viaduct.

#### FILTERS AND AQUEDUCTS

The increase in the quantity of water available for supply as a result of bringing the Ladybower Reservoir into use, made it necessary for the Board to increase the capacity of their Filtration Plant and Aqueduct. The conversion of the Slow Sand Filters at Bamford to Rapid Gravity Filters was carried out by direct labour and thereby the filtration capacity at Bamford was increased from 12 million gallons to 24 million gallons per day and with the appropriate chemical treatment an acid and peaty water, often possessing a fair degree of turbidity, is rendered slightly alkaline, sparkling and colourless.

So far as treatment is concerned, the original slow sand filtration works capable of treating 12 m.g.d. was brought into use in 1912 when the first supplies were provided and the general layout of the plant today is much as it was then, although the present extension covers the site of what was known as the "roughing filters". The function of the roughing filters, as the name suggests, was to eliminate much of the larger suspended solids before the water was passed to the slow sand filter beds, which are the present flocculators, wash water tanks, etc. The roughing filters were cleaned with compressed air and this technique was reputed to save considerable work in the manual cleaning of the slow sand filters. The pattern of treatment developments, summarily, is that the Yorkshire Bridge Filters were erected and brought into increasing use during the 1920's to supplement the original Bamford plant capacity and then the existing filters at Bamford were designed and constructed during the period 1942-44 as a replacement for the original slow sand filtration works.

The Yorkshire Bridge Filters were commissioned in 1929 and there the raw water is treated with chalk and aluminium sulphate before pressure filtration; the filtrate then passes to Bamford Filters for final pH correction and chlorination. The raw water entering Bamford Filters is also treated with chalk and aluminium sulphate and after flocculation, sedimentation and rapid gravity filtration, the combined filtrate from Yorkshire Bridge and the rapid gravity filters is corrected for pH value by the addition of hydrated lime to render it less corrosive and chlorinated before it enters the Aqueduct so as to eliminate bacteria. There was no contact or clear water tank at either Yorkshire Bridge or Bamford Filters.

It had been found, especially since the Aqueduct was cleaned and lined, that the filtration plants as they existed with a total capacity of 33 m.g.d. were not sufficiently flexible to cope with the peak conditions which might be envisaged. It was decided, therefore, by the Board in September, 1963, that the question of extending this plant be gone into most carefully, especially since portions of the plant had nearly reached the end of their useful life and would in any case have to be renewed in the near future.

The total filtration capacity of 33 m.g.d. was not adequate to cope with the average demand for treated water down the aqueduct, let alone meet any peak demands which might occur. Authorisation was obtained, therefore, in 1965 to extend the capacity of the works to 42 m.g.d. at the outlet (i.e. 9 m.g.d. from Yorkshire Bridge and Bamford extended from 24 m.g.d. to 33 m.g.d.). In addition, it was decided to modernise the chemical handling and dosing arrangements which were out of date. Construction commenced at the end of 1966.

In the new plant the raw water is treated before settlement with aluminium sulphate and lime and provision is also included for the addition of chlorine and chalk, which has proved its value in the existing works. The final treatment consists of pH correction by the addition of lime for corrosion control and chlorination to ensure complete freedom from bacteria. There is also provision for dechlorination by means of sulphur dioxide at this point.

Chemical Dosing throughout the modernised plant is as automatically controlled as possible related to criteria fed from various monitoring devices and flow meters—handling of material is also automated, all information being transmitted to the Control Room in the New Chemical Treatment Block.

After final treatment the water passes into a Contact Tank holding approximately 2 m.g. giving a retention time of approximately one hour at maximum output of 42 m.g.d. so as to allow the chlorine ample time to act, thus ensuring a completely bacteria-free water entering the aqueduct.

The water then flows South to Ambergate Reservoir and thence to supply the Southern Towns.

A third line of pipes, 48 inches in diameter, was laid between Derwent Dam and Bamford Filters, and the duplication of the pipelines between the Filters and Sawley was completed. This work involved the laying of about 26 miles of pipes varying in diameter from 39 to 48 ins.

#### ADDITIONS TO THIRD INSTALMENT

The completion of the Ladybower Reservoir Works brought to a conclusion the original schemes for impounding the head-waters of the River Derwent and brought the daily quantity of water from the Board's works available for supply to 38.0 million gallons per day.

Even before the Ladybower Reservoir works were completed it became apparent that the demand for water supplies was increasing at such a rate that further schemes should be considered for augmenting the Board's resources. Attention, therefore, turned to other tributaries of the River Derwent and between 1944 and 1956 statutory powers were obtained by the Board for abstracting water from the River Noe in Edale, the Peakshole Water in Castleton and the Bradwell Brook in Bradwell.

#### **RIVER NOE DIVERSION**

The Works for the diversion of the River Noe consist of a masonry intake weir, 12 feet high, forming a collecting pool in the River Noe and the water so collected is conveyed to the Ladybower Reservoir by gravitation in a covered concrete watercourse (5 ft. 6 in. wide, 6 ft. 6 in. deep and 2,135 yards long), and a concrete tunnel, 834 yards long, through the ridge dividing the Edale and Ashop Valleys. There is a steam Intake and Compensation Water Gauge in Jaggers Clough where the Board are under statutory obligation to discharge continuously into the River, 3.75 million gallons per day.

As there is no Reservoir in the Edale Valley and in dry weather the flow of the River Noe may be less than the statutory compensation water, provision has been made for bringing water from the Ashop Diversion Watercourse at such times. For this purpose a 15 inch pipe, with a total length of 2,400 yards, has been laid (partly under the tunnel invert) from the Ashop Valley to Jaggers Clough.

These works were inaugurated on the 18th April, 1951, by the then Chairman of the Board, Alderman John Clark, and increased the yield for the Board's Works by 4.5 million gallons per day.

#### LIMESTONE WATER from CASTLETON and BRADWELL

For the purpose of abstracting water from the Peakshole Water and the Bradwell Brook at appropriate points on each stream a weir, intake, collecting pond and automatic pumping station have been constructed.

The water so abstracted is pumped through an aqueduct  $3^{3}_{4}$  miles in length (part of which is a concrete lined tunnel 1,900 yards long through Win Hill) into the Ladybower Reservoir.

These works were formally inaugurated on the 7th July, 1960, by Alderman Mark Henig, a former Chairman of the Board.

The abstractions from the Castleton and Bradwell streams are estimated to yield a further supply of 4.984 million gallons per day.

#### SUPPLIES TO DERBYSHIRE LOCAL AUTHORITIES

The increases in yield from time to time have enabled the quantity of water originally allocated to the Derbyshire local authorities also to be increased and from the 1st April, 1962, the maximum aggregate quantity so allocated is 7.220 million gallons per day.

By a Statutory Order made in 1961, the South Derbyshire Water Board was constituted for the purpose of taking over the water under- takings of Derby Corporation and of twelve other Derbyshire Local Authorities.

The South Derbyshire Water Board has, therefore, succeeded to the rights formerly vested in the Derby Corporation to share in the Derwent Valley Water Board's supplies and to appoint three members to that Board. In addition, the South Derbyshire Water Board has the right to receive up to a maximum of 5.5 million gallons of water per day out of the 7.22 million gallons per day allocated to Derbyshire Local Authorities.

By a Statutory Order made in 1962 other water undertakings of Derbyshire Local Authorities were amalgamated into the North Derbyshire Water Board and that Board has the right to receive the balance of the Derbyshire Local Authority allocation up to a maximum of 1.72 million gallons of water per day.

#### SUPPLY AND COMPENSATION WATER

When the Water Resources Act, 1963, came into operation the Board became entitled to a licence of right to abstract water by means of their works and a licence has been granted authorising the Board to abstract up to 21,433,800,000 gallons of water for supply in any one year, subject to the discharge from their headworks into the River Derwent of compensation water amounting to 20,416,000 gallons per day.

The quantities of water supplied by the Board in the year ending 31st December, 1970, were:—

South Derbyshire Water Board	5,002 m.g	=	13.71 m.g.d.
Leicester Corporation	5,902 m.g.	=	16.17 m.g.d.
Sheffield Corporation	3,867 m.g.	=	10.59 m.g.d.
Nottingham Corporation	2,750 m.g.	=	7 .53 m.g.d.
North Derbyshire Water Board	382 m.g.	=	1.05 m.g.d.
Other Supplies	12 m.g.	=	.03 m.g.d.
	17,915 m.g.		49.08 m.g.d.

#### LANDS AND EASEMENTS

The Board owns upwards of 4,500 acres of land in and around the Howden, Derwent and Ladybower Reservoirs, and about 300 acres in the Edale Valley.

In lieu of purchasing the land required for the aqueducts, the Board have, for the most part, acquired from various landowners easements enabling the Board to construct the aqueducts and maintain them in perpetuity.

#### AFFORESTATION

Since 1908, the Board have carried out a systematic scheme of afforestation and the area planted at the end of 1970 was 2,002 acres. The Board have formally dedicated their plantations under the provision of the Forestry Acts of 1947 and 1951.

#### HOUSING ESTATE

The Yorkshire Bridge Housing Estate consists of 62 houses erected by the Board for occupation by persons whose houses were demolished in the construction of the Ladybower Reservoir, and by employees of the Board.

#### **CENTRAL STORES DEPOT AND WORKSHOPS**

In 1961 the Board completed the construction of a Central Stores Depot and Workshops on the Main Road, Bamford. In addition to providing accommodation for vehicles and other heavy plant and multifarious items for general maintenance, the buildings are also equipped with workshops for fitters, carpenters, blacksmiths, plumbers and electricians.

#### STATISTICAL INFORMATION

#### CATCHMENT AREAS AND RAINFALL

CATCHMENT AREAS		ACRES
First Instalment		
(Howden and Derwent Reservoirs)	 	13,280
Second Instalment		
(Ashop and Alport Diversions)	 	10,310
Third Instalment		
(Ladybower Reservoir)	 	7,610
River Noe	 	7,290
Parkin Clough	 	67
Limestone Scheme (approx.)	 	10,500
		49,057

#### RAINFALL

Average annual rainfall on the natural catchment area to Ladybower Dam over the 37 years 1934/1970 - 54.9 inches. (The true long period average is estimated to be 53.4 inches.)

Estimated reliable yield — 70 million gallons per day.

#### **CAPITAL EXPENDITURE**

The Capital Expenditure as at 31st December, 1970, amounted to  $\pounds 9,893,939$  made up as follows :—

			£
Land and Easements	 		347,483
Howden Reservoir	 		661,473
Derwent Reservoir	 		679,643
Ladybower Reservoir, including Viaduc	1,923,558		
Ashop Diversion	 		144,424
Noe Diversion	 		370,128
Limestone Area Works	 		534,340
Aqueducts and Service Reservoir	 		2,645,035
Bamford Filters	 		1,066,256
Yorkshire Bridge Filters	 		99,979
Yorkshire Bridge Housing Estate	 		65,758
Afforestation	 		23,225
Parliamentary Expenses	 		128,801
Other Capital Expenditure	 		317,064
Capitalised Interest	 		886,772
			£9,893,939

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LADYBOWER RESERVOIR



ASHOP DIVERSION





BAMFORD FILTERS



FILTERS AT YORKSHIRE BRIDGE FILTER HOUSE

## THE DERWENT VALLEY WATER BOARD.

### CATCHMENT AREA AND HEADWORKS.



